

DC BRUSHLESS MOTOR STRUCTURE

Background of the Invention

1. Field of the Invention

The present invention relates to a DC brushless motor structure that is comprised of fewer members, is easy to process and assemble, and is reduced to a minimized volume.

2. Description of the Related Art

Fig. 12 of the drawings illustrates a conventional DC brushless motor structure comprising a stator bobbin 90 having upper and lower pole plates 91 and 92 respectively mounted to an upper end and a lower end thereof. A metal axle tube 93 extends through the upper and lower pole plates 91 and 92, the stator bobbin 90, and a circuit board 94. A bearing 95 is mounted in the metal axle tube 93 for rotatably holding a shaft 97 of a rotor 96. A permanent magnet 98 is mounted to the rotor 96 and comprises a north pole and a south pole that cooperate with a magnetic force created in the edge of the upper and lower pole plates 91 and 92 for generating a repulsive force, thereby driving the rotor 96 to turn.

Fig. 13 of the drawings illustrates another conventional DC brushless motor structure comprising a stator 80 comprised of plural laminated silicon steel plates. Windings 82 are wound around the pole arms 81 of the stator 80. Engaged in a central portion of the stator 80 is an axle tube 83 that extends through a circuit board 84. A bearing 85 is mounted in the axle tube 83 for rotatably receiving a shaft 87 of a rotor 86. A permanent magnet 88 is mounted to the rotor 86 and comprises a north pole and a south pole that cooperate with a magnetic force created between the pole arms 81 for generating a repulsive force, thereby driving the rotor 86 to turn.

In these conventional DC brushless motor structure, since the upper and lower pole plates 91 and 92 (or the pole arms 81) and the metal axle tube 93 are used to create a magnetically conductive path for driving the rotor 96, 86,

1 the overall volume of the motor structures cannot be effectively reduced. In
2 addition, since the repulsive magnetic force created between the upper and
3 lower pole plates 91 and 92 (or the pole arms 81) and the permanent magnet
4 98, 88 for turning the rotor 96, 86 requires a magnetically conductive path
5 created by the upper and lower pole plates 91 and 92 (or the pole arms 81)
6 and the metal axle tube 93, an increase in the overall magnetic resistance is
7 caused, as magnetic resistance exists in the materials for these elements. The
8 rotational torque is adversely affected accordingly.

9 **Summary of the Invention**

10 It is an object of the present invention to provide a DC brushless motor
11 structure that is comprised of fewer members and is thus easy to process and
12 assemble.

13 Another object of the present invention is to provide a DC brushless
14 motor structure that is reduced to a minimized volume to thereby have a wider
15 application.

16 A further object of the present invention is to provide a DC brushless
17 motor structure in which a mutual repulsive force is created between a
18 magnetic field created as a result of energizing windings and a permanent
19 magnet having a north pole and a south pole without the need of creating a
20 magnetically conductive path by any magnetically conductive elements. Thus,
21 the magnetic resistance is reduced to the minimum and the DC brushless
22 motor has an improved rotational torque.

23 A DC brushless motor structure in accordance with the present
24 invention comprises a cylinder-like base having a through-hole or a chamber.
25 The through-hole acts as an axle hole for rotatably receiving a shaft of a rotor.
26 Alternatively, the shaft of the rotor is rotatably received in the chamber. An
27 axle hole is defined in an end of the base. Another axle hole is defined in a lid
28 attached to an end of the base. The shaft of the rotor is rotatably received in
29 the axle holes. At least two sets of windings are mounted to the base. Also

1 mounted to the base is an IC control member that is electrically connected to
2 the windings. A magnetic force is generated by a magnetic field that is created
3 as a result of energizing the windings to thereby repulse the permanent
4 magnet of the rotor having a north pole and a south pole, thereby driving the
5 rotor to turn.

6 Other objects, specific advantages, and novel features of the invention
7 will become more apparent from the following detailed description and
8 preferable embodiments when taken in conjunction with the accompanying
9 drawings.

10 **Brief Description of the Drawings**

11 Fig. 1 is an exploded perspective view of a first embodiment of a DC
12 brushless motor structure in accordance with the present invention.

13 Fig. 2 is a sectional view of the DC brushless motor structure in Fig. 1.

14 Fig. 3 is a sectional view taken along line 3-3 in Fig. 2.

15 Fig. 4 is an exploded perspective view of a second embodiment of the
16 DC brushless motor structure in accordance with the present invention.

17 Fig. 5 is a sectional view of the DC brushless motor structure in Fig. 4.

18 Fig. 6 is a sectional view taken along line 6-6 in Fig. 5.

19 Fig. 7 is an exploded perspective view of a third embodiment of the DC
20 brushless motor structure in accordance with the present invention.

21 Fig. 8 is a sectional view of the DC brushless motor structure in Fig. 7.

22 Fig. 9 is a sectional view taken along line 9-9 in Fig. 8.

23 Fig. 10 is a side view of a vibratory motor using the DC brushless
24 motor structure in accordance with the present invention.

25 Fig. 11 is a side view of a heat-dissipating fan using the DC brushless
26 motor structure in accordance with the present invention.

27 Fig. 12 is an exploded perspective view of a conventional DC brushless
28 motor structure.

1 Fig. 13 is an exploded perspective view of another conventional DC
2 brushless motor structure.

3 **Detailed Description of the Preferred Embodiments**

4 Preferred embodiments in accordance with the present invention will
5 now be described with reference to the accompanying drawings.

6 Referring to Fig. 1, a first embodiment of a DC brushless motor
7 structure in accordance with the present invention generally comprises a base
8 1 and a rotor 2.

9 The base 1 is a cylinder having a chamber 11 with an open end for
10 rotatably receiving the rotor 2, and a lid 17 is provided to enclose the chamber
11 11. An axle hole 12 is defined in the other end of the chamber 11. In this
12 preferred embodiment, an abrasion-resistant member such as a bearing 13 or
13 shaft sleeve is mounted in the axle hole 12 for rotatably receiving an end of
14 a shaft 21 of the rotor 2. At least two mounting members 14 are provided on
15 a wall of the vase 1. Each mounting member 14 may be a countersink in the
16 base 1 or an outwardly projecting peg shown in Fig. 1, and an associated
17 winding 15 is engaged on the peg 14. In order to allow the rotor 2 to turn, an
18 IC control means 16 comprising a conventional drive circuit and a Hall
19 element is mounted on the base 1 and electrically connected to the windings
20 15. The lid 17 has an axle hole 171. In a preferred embodiment, an abrasion-
21 resistant member such as a bearing 18 or shaft sleeve is mounted in the axle
22 hole 12 for rotatably receiving an end of a shaft 21 of the rotor 2.

23 The shaft 21 of the rotor 2 has a permanent magnet 22 mounted
24 therearound, the permanent magnet 22 having a north pole and a south pole.
25 Two ends of the shaft 21 are respectively, rotatably received in the axle hole
26 12 of the base 1 and the axle hole 171 of the lid 17. If necessary, two washers
27 23 are mounted on the shaft of the rotor and respectively located on two ends
28 of the permanent magnet 22 to avoid direct friction between the permanent
29 magnet 22 and the base 1 and avoid direct friction between the permanent

1 magnet 22 and the lid 17. An end of the shaft 21 may extend out of the base
2 1 via the axle hole 12 of the base 1 or the axle hole 171 of the lid 17.

3 As illustrated in Figs. 2 and 3, the base 1 has two mounting members
4 14 formed on the wall thereof for respectively engaging with two sets of
5 windings 15. The rotor 2 is received in the chamber 11 of the base 1, and the
6 lid 17 is engaged to the open end of the chamber 11 of the base 1. Two ends
7 of the shaft 21 of the rotor 2 are respectively, rotatably received in the axle
8 hole 12 of the base 1 and the axle hole 171 of the lid 17. The IC control
9 means 16 detects a change in the polarity of the permanent magnet 22 of the
10 rotor 2 and sends a signal to alter the polarity of the magnetic field created by
11 the sets of windings 15, thereby driving the permanent magnet 22 to turn by
12 a repulsive force and thereby allowing continuous rotation of the rotor 2.

13 Fig. 4 illustrates a second embodiment of the invention, wherein the
14 wall of the base 1 comprises at least one rib 19 on an outer face thereof, and
15 at least two mounting members 14 are provided on the wall of the base 1 for
16 mounting at least two sets of windings 15. An IC control means 16 is
17 mounted on the base 1 and a casing 3 is provided to enclose the elements.
18 Further, a lid 17 is provided to enclose an open end of the casing 3, best
19 shown in Figs. 5 and 6. Thus, the two sets of windings 15 and the IC control
20 means 16 can be protected by the casing 3.

21 Fig. 7 illustrates a third embodiment of the invention comprising a base
22 4 and a rotor 5.

23 The base 4 has a through-hole 41 that acts as an axle hole for rotatably
24 receiving a shaft 51 of the rotor 5. In a preferred embodiment, the through-
25 hole 41 has an inner diameter greater than an outer diameter of the shaft 51.
26 In addition, a lid 47 is mounted to an end of the through-hole 41 and has an
27 axle hole 471 for rotatably holding the shaft 51. In a preferred embodiment,
28 an abrasion-resistant member such as a bearing 48 or shaft sleeve is mounted
29 in the axle hole 471. The other end of the base 4 provides a support for an end

1 of the shaft 51. In a preferred embodiment, a support member 42 made of
2 abrasion-resistant material is provided on the other end of the base 4 and has
3 a concave arcuate recess 43 for providing a more stable fixed-point rotation
4 for the rotor 5. At least two mounting members 44 are provided on a wall of
5 the base 4 for mounting a corresponding number of sets of windings 45. An
6 IC control means 46 is mounted to the base 4 and comprises a drive circuit
7 and a Hall element. The IC control means 46 is electrically connected to the
8 windings 45.

9 An end of the shaft 51 of the rotor 5 extends through the axle hole 471
10 of the lid 47 and the bearing 48. The other end of the shaft 51 rests on the
11 support member 42 or in the arcuate recess 43 in the support member 42 to
12 provide the rotor 5 with a more stable rotation. A permanent ring magnet 52
13 is mounted to the rotor 5 and has a north pole and a south pole. The
14 permanent ring magnet 52 surrounds the base 4. If necessary, blades 54 may
15 be formed on the rotor 5 such that air current is driven when the rotor 5 turns,
16 thereby forming a heat-dissipating fan.

17 As illustrated in Figs. 8 and 9, the end of the shaft 51 of the rotor 5
18 extends through the axle hole 471 of the lid 47 and the bearing 48 and is then
19 retained in place by a retainer 53 such as a C-clip. The other end of the shaft
20 51 rests on the support member 42 or in the arcuate recess 43 in the support
21 member 42 to provide the rotor 5 with a more stable rotation. The permanent
22 ring magnet 52 of the rotor 5 surrounds the base 4 and is located in a position
23 corresponding to the positions of the windings 45. Thus, a repulsive force is
24 created between the permanent magnet 52 having a north pole and a south
25 pole and a magnetic field created as a result of energizing the windings 45.
26 And the rotor 5 is turned by the repulsive force.

27 Referring to Fig. 10, after assembly of the DC brushless motor, an
28 eccentric element 24 may be coupled to the shaft 21 extending beyond the lid
29 17 or the base 1, thereby using the DC brushless motor as a vibratory motor.

1 Alternatively, as illustrated in Fig. 11, a fan wheel 25 may be coupled to the
2 shaft 21 extending beyond the lid 17 or the base 1, thereby using the DC
3 brushless motor as a heat-dissipating fan.

4 The DC brushless motor structure in accordance with the present
5 invention has fewer elements and thus has a simplified structure that is easy
6 to manufacture and process. In addition, the magnetically conductive
7 elements such as the pole plates and the metal axle tube required in
8 conventional DC brushless motors are omitted in the DC brushless motor
9 structure in accordance with the present invention. The overall volume of the
10 DC brushless motor structure in accordance with the present invention is
11 reduced. Further, since the repulsive magnetic force for turning the rotor is
12 directly created between a magnetic field created as a result of energizing the
13 windings and the permanent magnet of the rotor, the magnetically conductive
14 path is largely shortened. As a result, the magnetic resistance is reduced to
15 thereby provide the rotor with a greater rotational torque.

16 Although the invention has been explained in relation to its preferred
17 embodiment as mentioned above, it is to be understood that many other
18 possible modifications and variations can be made without departing from the
19 scope of the invention. It is, therefore, contemplated that the appended claims
20 will cover such modifications and variations that fall within the true scope of
21 the invention.
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